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13. ABSTRACT (Maximum 200 words)

Graduate students nominated for support from this award included Chrisopher Bowman, Louis Rossi, and Julie Pullen. mr. Rossi received his PhD in May 1994 and subsequently accepted a post-doctoral position at Northwestern University. Ms. Pullen received her MS degree in December 1993 and transferred to the University of Washington where she is continuing her education. Mr. Bowman is currently continuing in the PhD program at the University of Arizona. Research investigations with faculty were in the areas of optics and patterns and computational fluid dynamics.

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PATTERNS AND TURBULENCE IN OPTICS AND FLUIDS

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Augmentation Awards for Science and Engineering Research Training
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Final Technical Report - June 30, 1995

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Research was conducted by the graduate students, Christopher Bowman, Louis Rossi, and Julie Pullen who were nominated for this Fellowship. Mr. Rossi received his Ph.D. in May 1994 and subsequently accepted a post-doctoral position at Northwestern University. Ms. Pullen received her M.S. degree in December 1993 and transferred to the University of Washington where she is continuing her education. Mr. Bowman is currently continuing in the Ph.D. program at the University of Arizona. Summaries of the work by Ms. Pullen and Mr. Rossi are contained in earlier Technical Reports.

Mr. Bowman has been the primary researcher during this period. He has worked in three main areas which are direct continuations of the research last reported. The investigation of the semiconductor laser has progressed somewhat from then. Problems arise from many of the integrals which come up in the analysis not converging. (Specifically, the integral needed to calculate the change in refractive index of the semiconductor.) This lack of convergence is of course not physical, but due to the approximations which go into the standard free carrier model. Several methods have been attempted to deal with these integrals, following the traditional methods used in semiconductor physics, but these are somewhat unsatisfactory. Other methods are being investigated, such as splitting the integrals into several parts, and handling the nonconvergent part using a different overall approximation.

Other work in the laser arena has been an investigation of the amplitude equations for a two level gas laser system with the addition of inhomogeneous broadening. Comparisons are being made between this system and the semiconductor system.

The second main area of research was in constructing an algorithm to determine a local amplitude and phase description of an almost periodic pattern. These patterns show up all over the place, and an algorithm for constructing local amplitude-phase descriptions of these patterns is a highly desirable goal. There has been little progress in this research area mainly due to the emphasis in the other two areas.

Finally, the third research area consisted of some analysis of the geometric properties of the Cross Newell phase diffusion equation. This study was based on the hodograph transformation of the phase diffusion equation and an investigation of how various solutions transform in this way. Some investigation was done on the gradient property of phase diffusion, and on its higher order corrections. It has been observed by Newell and Pomeau, that is a certain change of variables is implemented on the equation it can be transformed into a linear Helmholtz equation with higher order corrections. This transformation is similar to the Cole-Hopf transformation for Burgers equation, and appears to be a useful way for analysing the interaction of pattern defects.